get the water vapor condensed is an adequate cooling of the vapor, and with it (unavoidably) the other elements of the atmosphere. But the temperature of the air does not go down about an active wireless station any more rapidly, nor to a lower degree, than it does at other similarly located places.

Evidently, then, radio does not take water vapor out of the air and make it drier, thus increasing evaporation and subsequent rainfall. Neither does it prevent or decrease rainfall since it has no effect on any of the factors of either evaporation or condensation.

Again, drought may prevail in one region at the same time that another, with equal wireless facilities, is being flooded. Furthermore, droughts and floods, such as we now have, prevailed time and again throughout the world long before wireless was ever dreamed of.

Finally, from purely theoretical considerations, we know that the relatively small amount of energy used in broadcasting is not sufficient by millions of fold to produce any appreciable change in the amount of precipitation over either the United States as a whole, or even any one of its units.

However much radio may be affected by the weather, especially by the thunderstorm, no element of the weather is affected in turn by radio. We know this from experiment and observation, and we know it from theory as well.

AN ERROR IN THE MAXIMUM-THERMOMETER READING

By W. J. HUMPHREYS

In the case of the mercurial maximum thermometer that breaks its column at a point of constriction the reading always is too low if made after appreciable cooling. This is well known, but perhaps not as generally recognized and fully understood as it might be.

Let

V_m = the stem volume between consecutive degree marks at the time of maximum temperature.

V_t = the stem volume between consecutive degree marks when the temperature is t.

t_o = the stem reading at the point of break of column.

t = the temperature at time of reading.

t_m = the true maximum temperature.

t'_m = the maximum temperature as read.

M = the coefficient of the *volume* expansion of mercury.

G = the coefficient of the *volume* expansion of the thermometer stem—threefold the coefficient of its linear expansion.

The volume of the mercury column at the time of maximum temperature, is, of course, the volume of that portion of the stem then filled. That is, at the temperature t_m

$$\text{Volume of mercury} = \text{volume of glass} = V_m(t_m - t_o)$$

At the time of reading, however, or when the mercury has cooled from t_m to t, the volume of this same mass of mercury is

$$V_m(t_m - t_o) - MV_m(t_m - t_o)(t_m - t), \text{ or } V_m(t_m - t_o)\{1 - M(t_m - t)\}$$

while the original occupied stem volume has become

$$V_m(t_m - t_o)\{1 - G(t_m - t)\}$$

Hence the apparent or virtual shrinkage of the mercury, being the difference between the true shrinkage of the mercury and the true shrinkage of the glass, is

$$V_m(t_m - t_o)(M - G)(t_m - t)$$

Now the error of the reading evidently is the number of the unit stem volumes (volume between consecutive degree marks) whose total volume at the time of observation, when the temperature is t, is equal to the virtual shrinkage of the mercury since the temperature was t_m. Let this number be x, then

$$\begin{aligned} xV_t &= V_m(t_m - t_o)(M - G)(t_m - t) \\ &= V_m(t'_m + x - t_o)(M - G)(t'_m + x - t) \end{aligned}$$

From this equation the numerical value of x, the error in question in degrees, could be computed if we knew the ratio of V_m to V_t, since the values of all the other terms are known. Clearly,

$$V_t = V_m\{1 - G(t'_m + x - t)\}$$

But since G is very small, 0.000025, about, per degree centigrade, and $t_m - t$ seldom large, say, 20° C. at most, it follows that no observable error will be made by assuming V_t and V_m to be exactly equal to each other. With this assumption the value of x is readily computed.

To simplify, let

$$\begin{aligned} M - G &= d \\ t'_m - t_o &= a \\ t'_m - t &= b \end{aligned}$$

Then

$$x = (a + x)d(b + x)$$

Finally, since x is very small in comparison with either a or b, we can, without measureable error, write

$$\begin{aligned} x &= adb \\ &= (t'_m - t_o)\ (M - G)\ (t'_m - t) \end{aligned}$$

the form in which the value of this error commonly is expressed.

In practice this error, or value of x, seldom amounts to more than 0.1° F. or 0.2° F., and therefore for most purposes is negligible. It might be sufficient, however, to change a Weather Bureau's telegraphed value by 2°. Thus, suppose the reading taken just after maximum, is 91° +, F., and the reading some time later, following considerable cooling, 91° −, F. Owing to code exigencies the first would be reported as 92° F., and the second as 90° F. Fortunately, though, even this occasional error is of little importance, since it is the permanent station record of actual readings and not the ephemeral telegraphed reports that are considered in climatological and kindred studies.

In short this particular error of the maximum thermometer is of little to no importance in meteorology. Nevertheless, it is pleasant to know that there is such an error and reassuring to understand clearly when and why it may be ignored.